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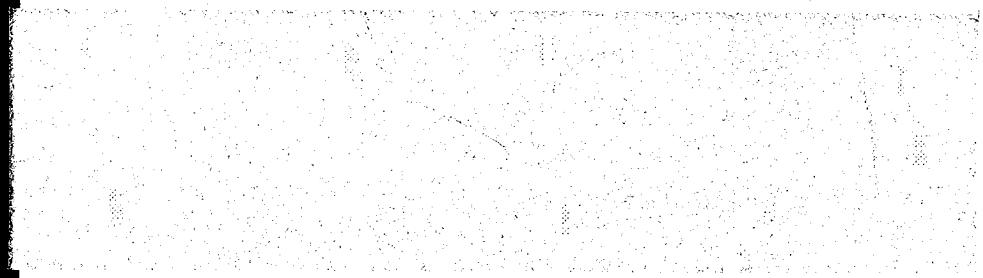

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Space Administration

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# N-Series HYPERchannel Engineering Evaluation

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# N-Series HYPERchannel Engineering Evaluation

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**Abstract**

This paper presents the results of performance testing of the Network Systems Corp. N-Series HYPERchannel local networking technology that was performed in early 1990 by the NAS Systems Development Branch at NASA Ames Research Center.

## 0.1 Introduction

HYPERchannel[1] is a high-speed local-area communication network which can use both coaxial and fiber-optic trunks to communicate between network devices. The network operates at a maximum rate of 100 million bits per second (Mb/s) over either medium. Hosts systems on the network are attached to the data trunks via specialized *adapter* boxes.

Each HYPERchannel adapter contains a microprocessor, control logic, and data buffer memory. One adapter can drive up to four independent network trunks. A host computer attached to the HYPERchannel network transmits and receives network messages via its associated processor adapter, e.g. an NB400. A basic set of commands and reponses is associated with each processor adapter. Specific adapter models implement these commands and responses according to the characteristics of the host system's I/O channel.

Currently, the local network at NAS employs the older A-Series HYPERchannel equipment. The present testing was performed in order to evaluate the next generation of this technology for possible use in the next generation of local networks at the NAS.

[1]Trademark of Network Systems Corporation

## 0.2 N-Series Host Adapters

The N-series host adapters are designed to be compatible with the older A-series HYPERchannel equipment. However, among the improvements made over the A-series are the ability to support simultaneous fiber and coax trunk connections, the ability to mix and match host/network interface types in the same box, and the ability to allow up to 8 "virtual circuits" to be active on the adapter simultaneously, whereas the A-series allowed only one. The N-series adapters can run their native N-series operating protocol or the A-series protocol, for backward compatibility.

The NB400 adapter is intended for interfacing VME-based workstations to the HYPERchannel. It has four ports for such connections, and can dynamically allocate its bandwidth among them.

The NB220 adapter can connect two IBM streaming-block-multiplexer I/O channels to the HYPERchannel network.

The NB130 interface provides interconnection of a single Cray low speed channel (LSP4) to the HYPERchannel network. The link layer protocol used by the NB130 allows it to operate at 200 Mb/s full-duplex.

## 0.3 Testbed Setup

A picture of the testbed used for the tests is given in Figure 1. NCT24's are fiber tranceivers, and ACT10's are coaxial tranceivers. The Sun workstations, Lotus and Bamboo, used IKON 10090 boards to interface to the NB400.

## 0.4 Connectivity

Connectivity is the capability of the computers interconnected by the network to freely exchange data with one another. Packet transfer was tested between all pairs of computers on the network. Each could send and receive packets correctly. Telnet, FTP, and ping were all shown to work successfully.

It can be seen in Figure 1 that fiber-optic and coaxial trunks were used side-by-side in the testbed. Although it is likely that all the traffic travelled over the fiber, no problems were observed to be caused by the existence of

the coax trunk. This shows, at least, that fiber (the newer of the two) works as a trunk medium.

## 0.5 Reliability

The only problem encountered in the course of this testing was a persistent message seen on the console screens of the two Sun workstations attached to the NB400. The message said that the NB400 had stopped responding to messages sent from the workstation. This message was always followed immediately by another announcing that communications had been restored. Such messages appeared often, and only during large file transfers. The cause of the message was never determined.

## 0.6 Performance Results

The performance of the N-series network was evaluated by using the TCP/IP protocol suite to transfer application-layer data between hosts. Three kinds of loopback tests were also performed to give low level performance data.

Higher level tests were done with a program called *ttcp* which opens a network socket to communicate via either TCP (the Internet reliable stream transport protocol) or UDP (the Internet user-level datagram transport protocol). In addition, a modified implementation of FTP (Internet file transfer protocol) was used to transfer data between systems (memory to memory) to acquire an understanding of what type of performance can be had at the user level.

### 0.6.1 NB400 Loopback Test Results

Loopback tests were done using a specialized utility called *hit*, which bypasses the middle-level protocols to talk directly to the HYPERchannel device driver, through a "raw" socket. The following results were obtained:

| | Mbits/sec |
|---|---|
| Local loopback from Bamboo to NB400 | 11.80 |
| Remote adapter loopback from NB400 to NB130 | 8.40 |
| Remote adapter loopback from NB400 to NB220 | 11.00 |
| Remote host loopback from Lotus to Bamboo | 8.20 |

Table 1 - Loopback Results

Loopback testing was not available from the NB130 (Cray) or NB220 (Amdahl).

## 0.7 Memory-To-Memory Results using TTCP

All values are in Megabits per second. Megabyte values along the left column refer to quantity of data sent per test.

### Lotus (Sun 3) to Bamboo (Sun 3)

| | TCP | UDP |
|---|---|---|
| 1 MB | 2.448 | 5.848 |
| 10 MB | 2.440 | 4.896 |

### Navier (Cray-2) to Bamboo (Sun 3)

| | TCP | UDP |
|---|---|---|
| 1 MB | 4.000 | 8.192 |
| 10 MB | 2.920 | 3.560 |

### Bamboo (Sun 3) to Navier (Cray-2)

| | TCP | UDP |
|---|---|---|
| 1 MB | 2.904 | 6.400 |
| 10 MB | 2.920 | 6.496 |

### Sandbox (Amdahl-UTS) to Navier (Cray-2)

| | TCP | UDP |
|---|---|---|
| 1 MB | 2.400 | * |
| 10 MB | 2.048 | * |

Table 2 - TTCP Memory-to-memory Results

* No measurements taken.

## 0.8 Memory-to-Memory Results using FTP

The following tests were done using an FTP modified to support memory-to-memory and multiple socket transfers. The columns in the table represent how many sockets were used in parallel for data transfer. Values are in Mbits/second, and are averages over several iterations.

| | 1 sock | 10 sock |
|---|---|---|
| Sun to Sun | 2.00 | 2.96 |
| Sun to Cray | 2.88 | 4.00 |
| Cray to Sun | 2.72 | 3.84 |
| Cray to Amdahl | 1.00 | 0.70 |
| Amdahl to Cray | 0.80 | 0.80 |
| Both Suns to Cray | * | 5.92 |
| Cray to Both Suns | * | 7.36 |
| Amdahl to Cray to Sun to Sun to Cray | * | 5.60 |

Table 3 - FTP Memory-to-memory Results

## 0.9 Conclusion

The results we obtained in this series of tests were not very good, considering that the network is rated at 100 Mb/s. The Amdahl domain and the device driver we were working with were somewhat unstable. This may explain, to some degree, the poor performance on the NB220 side. Nevertheless, it does not account for the poor performance overall. Also, the persistent adapter error messages on the Suns were discouraging. In conclusion, the N-series HYPERchannel has not been observed to perform at a level sufficient to support the EOC requirements of the NAS Processing System Network.

* No measurements taken.

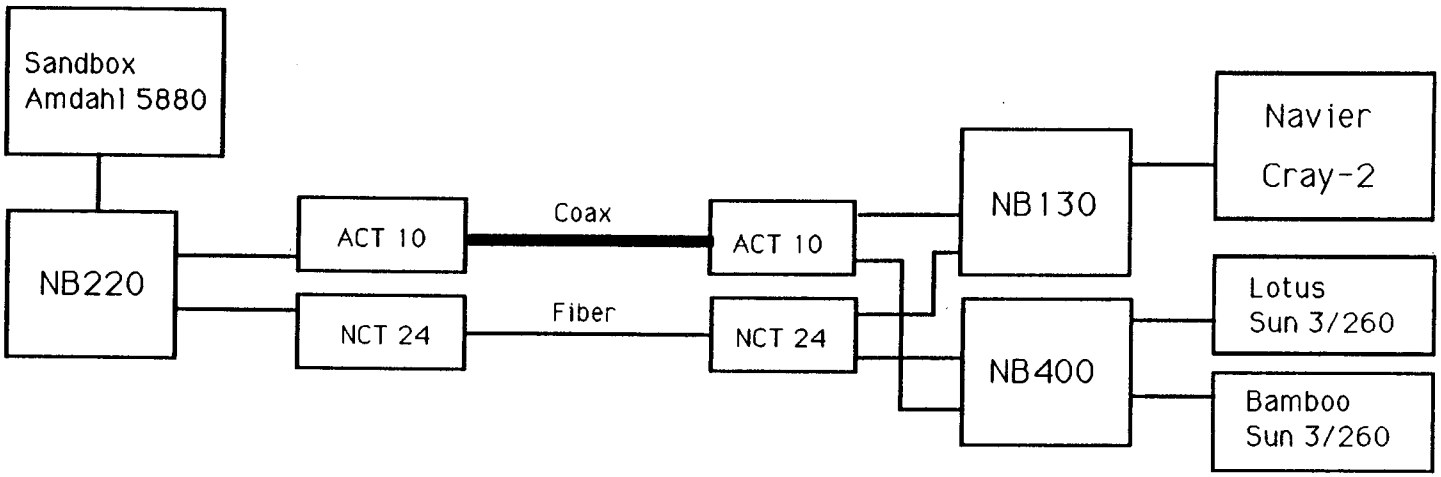
Sandbox
Amdahl 5880
NB220
ACT 10
NCT 24
Coax
Fiber
ACT 10
NCT 24
NB130
NB400
Navier
Cray-2
Lotus
Sun 3/260
Bamboo
Sun 3/260

Figure 1